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Development of Metacognition and Self-Regulated Learning in Young Children: Role of Collaborative and Peer-Assisted Learning

Abstract

The authors present findings from a large 2-year study exploring the development of self-regulatory and metacognitive abilities in young children (aged 3 to 5 years) in educational naturalistic settings in the United Kingdom (English Nursery and Reception classrooms). Three levels of analysis were conducted based on observational codings of categories of metacognitive and self-regulatory behaviors. These analyses supported the view that, within the 3- to 5-year age range, there was extensive evidence of metacognitive behaviors that occurred most frequently during learning activities that were initiated by the children, involved them in working in pairs or small groups, unsupervised by adults, and that involved extensive collaboration and talk (i.e., learning contexts that might be characterized as peer-assisted learning). Relative to working individually or in groups with adult support, children in this age range working in unsupervised small groups showed more evidence of metacognitive monitoring and control. Relative to children in supervised groups, they also showed more evidence of "other" and "shared" regulation. The implications for research, theory, and educational practice are discussed.

Key words: metacognition, self-regulation, peer-assisted learning, early childhood education

Theoretical and Methodological Background

We present relevant findings from a large 2-year study exploring the development of self-regulatory and metacognitive abilities in young children (aged 3 to 5 years) in educational naturalistic settings in the United Kingdom (English Nursery and Reception classrooms). The main research question driving this study related to the issue of whether metacognitive abilities are relatively late-developing (not emerging until middle or late childhood) or whether, given more sensitive methods, they could be observed in much younger children. In previous papers (Whitebread et al., 2005a, 2005b) we have presented initial data and analysis supporting the view that metacognitive and self-regulatory abilities can be seen to be emerging in the age 3 to 5 group. A subsidiary finding, however, has been that different learning contexts (e.g., working individually, in a small group, with an adult) appear to afford differential opportunities for

children to experience and practice their metacognitive skills. We report here a set of analyses focused specifically on this latter issue. In particular, we have attempted to investigate the extent to which different forms of collaborative or peer-assisted learning can be seen to afford children different or enhanced opportunities in this regard.

In early research investigating metacognition with children, the emphasis tended to be on what young children could not do. Right from the outset, the seminal work on metamemory by Flavell, Beach, and Chinsky (1966) developed the key notion of the "production deficit" that resulted in children under the age of 7 years being incapable of producing a known memory strategy appropriately. In much of the early work, emphasis was placed on the examination of metacognitive knowledge using self-report methodologies. The study by Kreutzer, Leonard, and Flavell (1975), which found that young children were limited in their ability to report about their own memory abilities and strategies, is typical of this period. This view, that metacognition is a sophisticated set of abilities that does not begin to emerge until around the age of 8 years, is one that is still widely accepted (Veenman, Van Hout-Wolters, & Afflerbach, 2006).

There is increasing evidence, however, that the metacognitive abilities of young children may have been significantly under-estimated in early self-report and laboratory-based studies. Winne and Perry (2000) have argued that this arises for two significant reasons. First, the pitfalls of relying on young children's abilities to self-report are well documented. Second, in many areas of development it has been clearly established that young children's performance and the efficacy of their learning is highly influenced by the social and other contextual features of the situation in which they are placed. Certainly, a number of researchers have demonstrated the advantages of naturalistic, rather than laboratory-based, studies with young children and of the advantages of using observation schedules and techniques to evaluate their metacognitive learning. In Istomina's (1975) celebrated study of young children's memory performance, for example, children were involved in a pretence game involving a tea party and were asked to remember items to buy from a store on the other side of the room. In these circumstances, where the children clearly understood the purpose of remembering, they showed evidence of awareness of forgetting, and simple strategies to avoid it, as young as 5 years of age. Many other studies have subsequently documented evidence of the early deployment of metacognitive processes by very young children when they are supported by a meaningful context (Blöte, Resing, Mazer, & Van Noort, 1999; Deloache, Sugarman, & Brown, 1985).

In line with this kind of evidence, a meta-analysis of studies addressing metamemory – memory performance relations carried out by Schneider and Pressley (1997) highlighted the impact of contextual factors in the deployment of metacognitive and cognitive abilities, especially in the case of young children. When analyzing the relationship between memory monitoring and performance, for example, they showed that, depending on the specific requirements of the tasks, correlations between memory monitoring and performance can be substantial even for young preschool children. They concluded that the size of correlations varies depending on a series of factors including the aspects of metamemory being assessed, the types of memory tasks, levels of task difficulty, and the presentation of metacognitive assessment before or after memory tasks.

This sensitivity to context evidenced in relation to young children's metacognitive performance is, of course, of particular significance in the educational arena. The present analysis was

conducted specifically to examine the impact of differing learning contexts, including working in small groups with peers, on children's metacognitive and self-regulatory performance.

Pedagogy of Self-Regulation

That metacognition and self-regulation are important areas for research in educational psychology is supported by the gathering evidence of the overwhelming significance of metacognitive skillfulness for learning (Veenman & Spaans, 2005; Wang, Haertel, & Walberg, 1990) and of the efficacy of educational interventions intended to promote metacognitive and self-regulatory abilities, particularly with young children (see meta-analyses of intervention studies by Hattie, Biggs, & Purdie, 1996, and Dignath, Buettner, & Langfeldt, 2007).

Significantly, within these meta-analyses and in other reviews of pedagogy in this area (Boekaerts & Corno, 2005; Lin, 2001), a distinct shift has been identified from the direct teaching of metacognitive skills and strategies to more emphasis on changes in traditional classroom arrangements and the creation of social environments to support metacognition. Two key elements of such social environments that can be identified more broadly from various elements of the research literature relate to the essentially social processes of learning, and the importance of the emotional and motivational context.

As regards the first issue concerning the social nature of learning, this is very much in line with the dominant theoretical contribution within the educational literature, which is to conceptualize the processes whereby children develop self-regulatory and metacognitive abilities within a Vygotskian framework. Learning to be an effective learner, according to this approach, is a process of acculturation and internalization whereby the child moves from being other-regulated to being self-regulated. Zimmerman and Schunk (2001) have been significant contributors to this area of thought and research.

Work within the Vygotskian approach has traditionally, of course, emphasized the significance of mediation by an adult, and the impact of sensitive and contingent "scaffolding" in supporting children's learning. However, there are a range of studies that have explored the significance of children's collaborative or peer-assisted learning of various kinds in the process of internalization of learning, and particularly in relation to the development of metacognitive and self-regulatory abilities. To begin with, as Karpov (2005) has recently reminded us, Vygotsky himself identified children's sociodramatic play as having a significant role in the development of self-regulation (Vygotsky, 1978), a contention that has been supported by a range of research mostly focussing on attentional and emotional self-regulation (Elias & Berk, 2002). Intriguingly, when looking at the specific mechanisms of learning development, Vygotsky also argued that children's use of verbal tools to regulate the behavior of others was a significant factor in their development of self-regulation. A study of 3- to 7-year-old children "standing sentry" by Manuilenko (1948) illustrated how this might work. Children standing sentry in a room containing playmates managed to stand motionless for significantly longer than when they were on their own. This appeared to be a consequence of the playmates "monitoring" the "sentry's" performance.

Within the educational sphere, neo-Vygotskians have demonstrated the efficacy of peer interaction in other more purely cognitive and metacognitive areas. In a series of studies, Forman and Cazden (1985) developed a range of collaborative group work techniques that obliged

children to articulate their own understandings, evaluate their own performance, and be reflective about their own learning. Palincsar and Brown (1984) developed and demonstrated significant gains from the use of "reciprocal teaching," a structured procedure that involved teachers modeling the teaching of a particular task to children who were then, in turn, asked to teach the activity to their peers.

Research carried out in the area of problem-solving in small groups has also suggested that collaborative group work and peer tutoring can make important contributions to the development of metacognitive abilities (Iiskala, Vauras, & Lehtinen, 2004; Vauras, Iiskala, Kajamies, Kinnunen, & Lehtinen, 2003). These researchers have also made important advances in analyzing the interrelated social and cognitive processes that might account for this contribution. They have observed that during episodes of true collaboration, cognitive regulation processes fluctuate among three levels: self, other and shared regulation. *Self* regulation refers to the traditional concept regarding the monitoring and control of individual performance, or intrapersonal regulation. *Other* regulation relates to the situation in which one partner masters a key element of the task but the other(s) does not, so that one partner instructs the other(s). Finally, *shared* regulation defines an "egalitarian, complementary monitoring and regulation over the task" (Iiskala et al., 2004, p. 150).

This interpersonal level of metacognition referred to as *other* or *shared* regulation exhibits two significant characteristics that distinguishes it from purely intrapersonal metacognition with regard to the cognitive activity involved, and that may enhance its contribution to metacognitive learning. First, working through collaboration allows a reduction in cognitive processing load, which, in itself, may facilitate enhanced metacognitive activity (Whitebread, 1999). Second, at the same time the participants need to monitor and regulate the reciprocal use of the joint representation of the task, which obliges them to externalize and articulate their ideas and conceptions to others (Iiskala et al., 2004).

Perry, VandeKamp, Mercer, and Nordby, (2002) have provided evidence that also supports the role of peer-assisted learning in this area, derived from extensive observations in kindergarten to grade 3 classrooms in British Columbia, Canada. They observed young children planning, monitoring, problem solving, and evaluating their learning mostly in relation to reading and writing tasks. The pedagogical elements that emerged as being most effective in promoting self-regulated learning in these classrooms involved the teachers in offering choices to the children, in offering opportunities for the children to control the level of challenge in tasks and opportunities for children to evaluate their own work and that of others. Their detailed analysis of the classroom discourses of teachers who were highly effective in this area revealed a complex and highly skilled set of practices whereby all kinds of instrumental supports were provided to enable the children to develop metacognitive learning skills and dispositions. The use of cooperative ways of working emerged as one of the two most significant elements in these support structures.

The other significant element of early years classrooms that appeared to support self-regulation and metacognition identified by Perry related to the emotional and motivational context, which we identified above as the second key element of social environments identified in the reviews of pedagogy by Boekaerts and Corno (2005) and by Lin (2001). Perry et al. (2002) mentioned particularly the presence of an evaluative style in these classrooms that was nonthreatening and mastery-orientated. The clear relationship between cognitve and motivational aspects of

metacognition was recognized early in Weinert and Kluwe's (1987) edited collection entitled *Metacognition, Motivation and Understanding*. A number of chapters here, for example, focused on the metacognitive aspects of attributions of success and failure. In this general coming together of different research traditions, the cognitive psychologists have taken over the notion of self-regulation from motivational research, and theories of emotional development have gradually taken on board the ideas about increasing self-awareness and self-knowledge from the work on metacognition, culminating, amongst other things, in the emergence of the model of emotional intelligence (Goleman, 1995). Understandings emerging from neuroscience also support a model that integrates emotional and cognitive aspects of self-regulation. The development of metacognitive, self-regulatory executive functions appears to be related to developments in the frontal lobes that are also involved in various kinds of behavioral inhibition (Barkley, 1997). According to the developing model of self-regulation emerging from these developments, self-regulated learning involves the interaction of thoughts, feelings, and purposive actions flexibly managed by the learner to achieve personal goals (Pintrich, 2000).

Method

Participants

The Cambridgeshire Independent Learning in the Foundation Stage (C.Ind.Le) project involved 32 early-years educators in Cambridgeshire, England and the 3- to 5-year-old children in their classes. Altogether, over the 2 years of the project, this involved approximately 1,440 children, of whom half were in the younger "nursery" class age range of 3 to 4 years, and half in the older "reception" class age range of 4 to 5 years. At the time of the observations made within the study, the younger children were all in the range 3.2 to 4.5 years (mean, 3.9 years) and the older children were all in the age range 4.2 to 5.5 years (mean, 4.9 years).

The educators were selected to be included in the project based on evidence of their high level of skill as early-years educators and their willingness to be involved in a project that would require them to engage in innovative practices. They were also selected so that the whole cohort comprised a representative sample of types of preschool provision and socio-economic catchment area in the Cambridgeshire region. Of the 32 classes, 16 were nursery and 16 reception; 10 were in rural settings, 8 were urban or inner-city, 8 were suburban or in predominantly professional areas, and 6 were in mixed small town catchments.

Procedures

During the 2 years of the project, the participating educators collected evidence of metacognitive abilities evidenced by children in their classes during learning activities that were constructed to be "meaningful" for the children and in other ways most likely to facilitate children's articulation of their metacognitive knowledge and self-regulation of their performance (e.g., involving planning, problem solving, peer tutoring, collaborative group work, reviewing learning). These learning activities included child-initiated play of all kinds, both individually and in small groups, and other activities provided by the teachers involving children working individually and in small groups. In all these situations, children sometimes worked alone and sometimes were supported by the involvement of an adult. The evidence collected of metacognitive and self-regulatory abilities consisted of "events" video recorded of the children engaged in the various learning activities.

An analytical model of cognitive self-regulation, developed originally by one of the present authors (Pino Pasternak, 2006), was used and developed within the project. This attempts to incorporate significant aspects of self-regulation that, according to the current research evidence, appear to have an impact on the emergence of self-regulated cognitive activity. This model involves three main areas:

- *Metacognitive knowledge* (Flavell, 1987): the individuals' knowledge about personal, task, and strategy variables affecting their cognitive performance

- *Metacognitive regulation* (Brown, 1987): the cognitive processes taking place during ongoing activities; involves planning, monitoring, control, and evaluation

- *Emotional and motivational regulation* (Boekaerts, 1999; Corno, 2001; Zimmerman, 2000): the learner's ongoing monitoring and control of emotions and motivational states during learning tasks

The coding framework developed within the project to analyze the self-regulatory events identified is reported in the Appendix at the end of this paper. This includes operational definitions of each of the categories of behavior, together with operational descriptions of behavior related to each category and examples taken from the video recorded events.

Data analysis

Analyses were conducted at three levels. First, from all the video data collected, 582 events (lasting from a few seconds to as long as 5 to 6 min, but usually averaging around 2 to 3 min) were identified as showing general evidence of metacognitive or self-regulatory behaviors (involving all of the children in the sample at least once and in many cases on several occasions). From this initial analysis, a subset of 196 events (about a third) were selected that showed the clearest evidence and that were representative of the whole data set across curriculum areas of the learning activity, group size, and level of adult involvement. Equal numbers of events from nursery and reception classrooms were also included in this selection, to adequately represent the age range. This subset included data from 1062 children or 73.8% of the total sample, with approximately half in each age range. These 196 events were subjected to more detailed analysis for evidence of behaviors demonstrating metacognitive knowledge, metacognitive regulation, and emotional and motivational regulation. Finally, to focus specifically on the issue of peer-assisted learning, a further subset of 60 events (30 in each age group) were selected (just over 10% of the total events identified and including data from 260 children, or 18.1% of the total sample). These represented the 20 events of individual children working alone without any adult involvement, of small groups without any adult involvement, and of small groups with adult involvement which, from the previous analysis of 196 events, had emerged as having the highest frequencies of metacognitive and self-regulatory behaviors. As such, they may be taken to represent what appears to be achievable in these three learning contexts with children in the 3 to 5 age range, certainly as represented in our data.

Within this final analysis of 60 events, behaviors were coded at the most detailed level of categories represented in the coding scheme reproduced in the Appendix. Further, for each of the categories, an additional analysis was conducted of the self, other, or shared focus of the

behavior, adopting the definitions developed by Iiskala et al. (2004). The operational definitions of these focuses are reported in Table 1.

For the analyses of the 196 events and of the 60 events, interrater reliabilities were calculated. At the level of the 196 events, 20 events (just over 10% of the data set) were selected for this purpose, which two observers coded independently. The analysis of interrater agreement was carried out by calculating percentages of absolute agreement (i.e., the extent to which the observers agreed that the behavior observed constituted a unit of coding and assigned the same code). This level of agreement was 74.8%.

Table 1. Operational Definitions of Self, Other, and Shared Nature of Regulation Processes

Focus of regulation	Operational definition
Self-regulation	Regulation processes directed mainly to regulate children's own processes, with no apparent intentions to influence other children's cognitions, emotions, or behaviors. It may include verbalizations regarding the child's own activity such as "I am going to make a big circle" or "I can count backwards" or evidences of nonverbal behavior indicating monitoring or regulation of cognition in order to achieve a personal goal.
Other-regulation	Regulation processes directed to influence the cognition, motivation, or behavior of one specific member of the group. This interaction always reveals certain asymmetry in the relationship. There are two different cases: - peer tutoring in which one child monitors or controls another child who might need some help with some aspects of the task - when one child is trying to influence another child's behavior either because the second is not doing well in the task or is not behaving properly in order to carry out the activity (e.g., disengaged from the task, inactive, disruptive)
Shared-regulation	Regulation processes more related to group planning, monitoring, and regulation of a joint activity. The verbalizations are usually directed to everyone in the group (or no one in particular) and the talk is more about what has to be done than about what someone has to do. The talk is mainly in the plural such as "We should do this," or "We are taking too long."

At the more detailed, and for the purposes of this paper, more crucial level of analysis of the 60 events, however, this process was refined further according to the recommendations of Bakeman and Gottman (1997) for the kind of socially based categories attributing meaning to the verbal and nonverbal behaviors of children with which we are dealing in this kind of analysis. Typically, the main area of difficulty for this kind of behavioral coding is in precisely defining what constitutes a codeable unit of behavior. It is, therefore, important to separate out this difficulty at the level of agreement in "unitizing" from an assessment of the agreement at the level of codes assigned to identified units of behavior (i.e., the level of "absolute" agreement).

For the 60 events, 12 events (20% of the sample) were selected for the purposes of examining interrater reliability. At the level of unitizing, the level of agreement was 66.0%, and at the level of absolute agreement, it was 96.1%. This disparity between the two elements of this process bears out the distinction made by Bakeman and Gottman, but also compares favorably with rates of interrater reliability commonly found with this kind of observational coding. While the difficulties of defining precisely what constitutes a codeable unit of behavior are evident, it is also clear that the distinctions between the various categories in the coding scheme we have developed can be maintained at a very high level of agreement. Interrater reliability was also calculated for the categorization of behaviors according to whether they were focused on self, other, or shared regulation. The level of agreement here was 86%.

Results

582 Event Analysis

In the first general analysis of all 582 events identified in the whole data set, there were some initial indications of the possible significance of learning contexts that involved elements of peer-assisted learning. These related to issues of initiation of activities, group size and degree of collaboration and talk. Of these 582 events, 376 (64.6%) were child initiated, while only 114 (19.6%) were adult initiated and 92 (15.8%) were jointly initiated. Similarly, while only 21 (3.6%) involved a whole class working together, and 116 (19.9 %) involved individual children working on their own, an impressive 445 events (76.5%) involved children working in pairs or in small groups. Finally, these 582 events were analyzed for the degrees of both collaboration and talk, according to whether there was none or it was intermittent or extensive. Figures for the numbers of events showing no collaboration and talk were 155 (26.6%) and 44 (7.6%), respectively; for intermittent levels, the figures were 148 (25.4%) and 144 (24.7%); and for extensive levels, they were 279 (47.9%) and 394 (67.7%).

Taken together, these initial data suggested that, within the 3 to 5 age range, we were finding extensive evidence of metacognitive behaviors that most frequently occurred during learning activities that were initiated by the children, that involved them in working in pairs or small groups, and that involved extensive collaboration and talk.

196 Event Analysis

At this second level of analysis, further indications emerged supporting the notion that learning contexts supporting children to learn from one another might be beneficial in relation to aspects of metacognitive learning. At this level of analysis, for each of the 196 events, behaviors involving the deployment of metacognitive knowledge, metacognitive regulation, and emotional

and motivational regulation were coded and the rates at which they occurred calculated. Figure 1 shows the rates at which these behaviors occurred in relation to the size of group in which the children were playing or working.
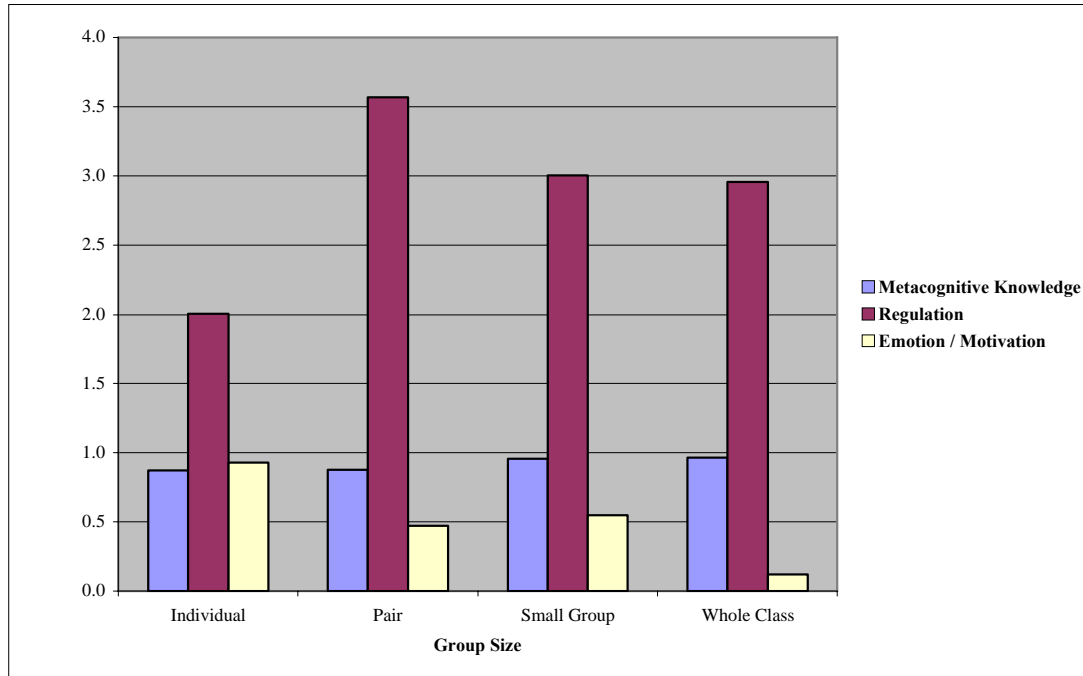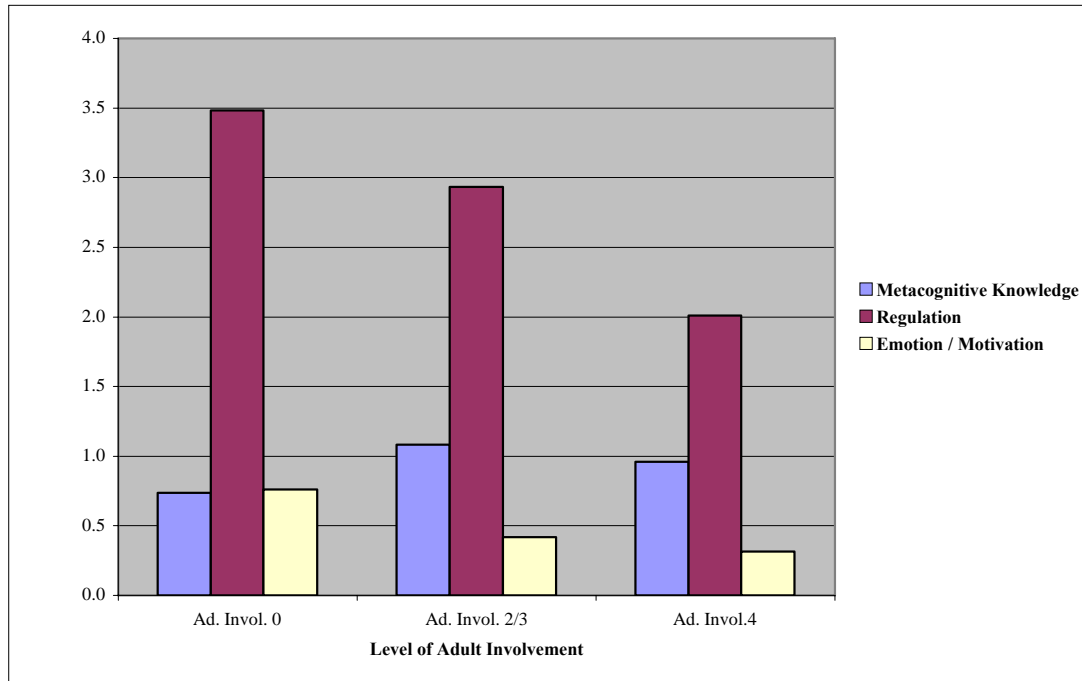

Figure 1. Mean rates of metacognitive behaviors by group size (196 events).

This result indicates that more evidence of metacognitive regulation occurred when the children were in pairs or groups than when they were working individually. Conversely, however, there was evidence of more emotional and motivational regulation when the children were working individually. Levels of deployment of metacognitive knowledge, though, appeared to be unaffected by this aspect of the learning context. In this analysis, however, no distinction is made between children working in groups with or without adult intervention or support. Figure 2 shows the rates at which metacognitive and regulatory behaviors occurred in relation to the level of adult involvement.

This analysis indicates a clear decline in levels of the children's behavior involving metacognitive regulation and emotional and motivational regulation as adults became more involved in the learning activities. Conversely, a slightly higher rate of behaviors involving the deployment of metacognitive knowledge was evidenced when adults were involved in activities than when they were not. It seems likely that when adults are working with children in their age-group they tend to take over the regulatory role, but also tend to stimulate the children to reflect more frequently on and articulate what they know about their own learning.

Finally, for the 196 events, Figure 3 shows an analysis based on the type of cognitive activity involved in the various learning activities. The significance of this particular analysis should not

be over-played, as the distinctions between the various activities were mostly post-hoc, and many of them could be characterized as belonging to more than one category; for example, some planning was collaborative, as was much of the imaginative play and some of the problem-solving. However, it is interesting to note that events which were most distinctively characterized as involving "peer tutoring" or "collaborative group work" evidenced the second and third highest rates of metacognitive regulation behaviors and behaviors involving the articulation of metacognitive knowledge.

0 = no adult involvement; 2/3 = intermediate levels, including intermittent involvement and non-directive involvement; 4 = activity directed by an adult throughout.

Figure 2. Mean rates of metacognitive behaviors by levels of adult involvement (196 events).
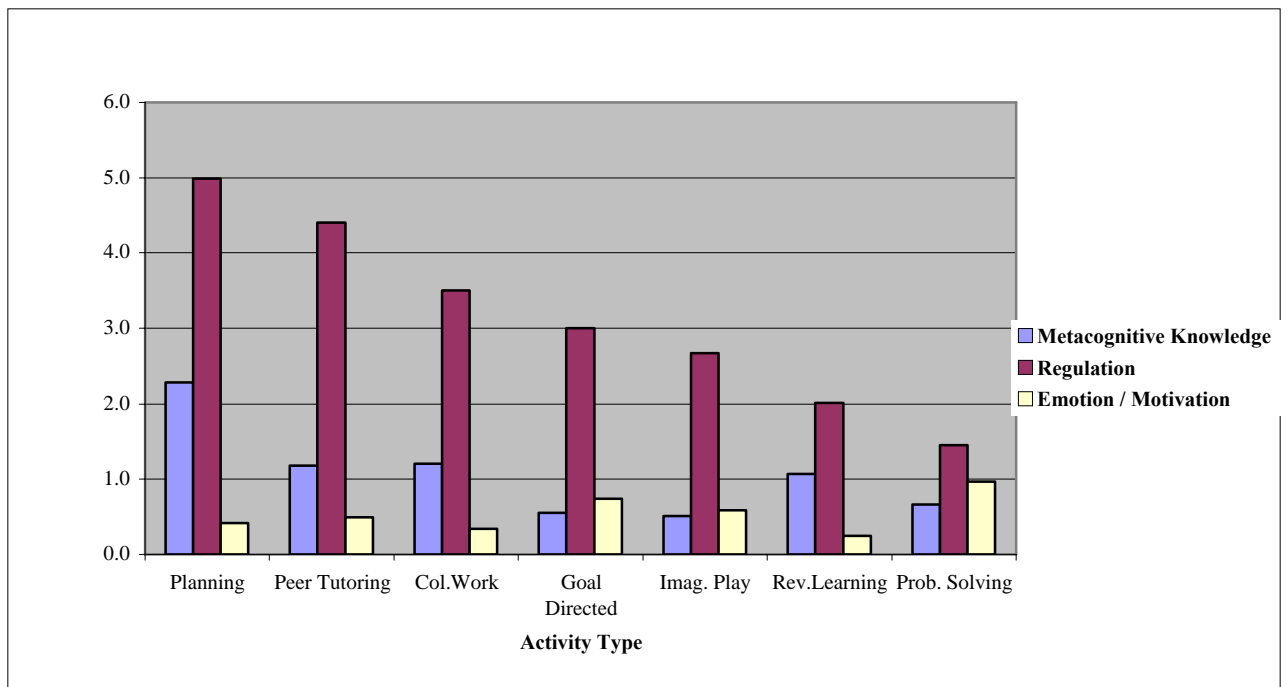
Figure 3. Mean rates of metacognitive behaviors by activity type (196 events).

Taken all together, these various more detailed analyses of metacognitive and self-regulatory behaviors within the 196 events provide further support to the suggestion that there may well be educational benefit in children working in groups without adult supervision.

60 Event Analysis

Arising from these earlier rather general explorations of large numbers of events, it was decided to carry out an analysis specifically aimed at pursuing the issue of the impact of learning contexts on the children's metacognitive and self-regulatory behaviors. For this purpose, 60 events were selected for more detailed coding and analysis, as described above. The results of a one-way ANOVA of the rates of occurrence for the various categories of behavior are reported in Table 2. As can be seen, a number of highly significant differences emerged within this analysis between the metacognitive and regulatory behaviors shown by the children in the three learning contexts. The children in the group without adult support or supervision were significantly more likely to engage in behaviors showing evidence of metacognitive monitoring ($p < 0.01$) than children working individually, and significantly more likely to engage in behaviors showing evidence of metacognitive control than children working in a supervised group ($p < .05$) or individually ($p < .001$).

They showed more evidence of overall metacognitive regulation (i.e., planning, monitoring, control, and evaluation combined) than the children in supervised groups ($p < .05$), who in turn showed more evidence in this combined category than children working individually ($p < .05$).

Moving to the foot of the table, while the levels of "self" regulation were not significantly different among the three groups, there were significant differences in relation to "other" and

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"shared" regulation. Children working individually, of course, could not, by definition, engage in these kinds of regulatory activity. However, it is significant that the unsupervised groups showed evidence of statistically more "other" regulation than individuals ($p < .001$), while supervised groups did not. Unsupervised groups also showed significantly more "shared" regulation than supervised groups ($p < .001$) or individuals ($p < .001$).

Given the significance of this distinction between "self," "other," and "shared" regulation (as suggested by work within the Vygotskian tradition, and by the more recent work of Vauras et al., 2003, and others), and its particular relation to the educational notion of peer-assisted learning, it is perhaps worth considering the qualitative nature of these different behaviors for children working individually, in groups with adult support, and in groups without adults.

By their very nature, the observations of a single child working alone were made up entirely of behaviors exemplifying self-regulation, rather than other- or shared-regulation. As they only occasionally verbalized their thoughts (perhaps in around a quarter of the "events") most of the evidence here was nonverbal. Specifically, planning was most typically exemplified through behaviors in which children were seeking out materials necessary for a task or deciding between two items (e.g., colored pegs, puzzle pieces) before deciding which one to use on a task. The most commonly observed monitoring behaviors tended to be those in which the child demonstrated nonverbal evidence of checking his or her performance or noticing an error through a gaze or pause during action, which may or may not have been followed by re-direction of the child's activity. A verbalized example here was of a boy making a diary in the "Office" who said to himself, "Oh no, this is not the right paper! I need that sort," as he looked at a pile on the other side of the desk. Control behaviors were most typically exemplified by the use of strategies on-task such as using gesture to support one's own cognitive activity (e.g., counting on fingers, enumerating listed points of a verbalized list using fingers), or applying a previously-learnt strategy to a new situation (e.g., child stretches string taut so as to cut it after having previously successfully cut the string held taut wound round a pillar). Occasional self-commentary also clearly had a control function; for example, a boy engaged in subtraction sums generated by rolling a die changed his strategy commentating as follows: "That goes there … so roll the dice … and count the (dots) …1,2,3,4 … take away … take away … 4 … equals … equals …."

While such self-directed behaviors continued to be evident in observations of children working in groups, in both supervised and unsupervised groups there was a good deal more verbal regulatory behavior, and other behaviors exemplifying attempts at regulating the cognition or behavior of other children in the group (other-regulation) or those related to group construction of a task (shared regulation) also arose. In groups supervised by an adult these remained less frequent (0.61 and 0.60 occurrences per min) than self-regulatory behaviors (2.46 per min). In groups without adult supervision, however, "other" regulation (1.31 per min) was nearly as frequently observed as that which was self-directed (1.50 per min), and "shared" regulation was observed almost twice as frequently (2.79 per min).

Table 2. One-Way ANOVA: Comparison of Rates per Minute of Incidence of Metacognitive Behaviors Across Learning Contexts (60 Events)

Learning context	Group with adult (GA)		Group without adult (G)		Individual (I)		Total		F	Post-hoc comparisons (Tukey HSD)
	M	SD	M	SD	M	SD	M	SD		
Metacog know	0.14	0.57	0.24	0.78	0.00	0.00	0.12	0.56	1.80	*NS*
Planning	0.51	1.03	1.12	2.55	0.26	0.47	0.63	1.64	3.00	*NS*
Monitor	2.10	2.33	2.56	3.46	0.84	1.00	1.83	2.56	5.23**	G > I ($p<.01$)
Control	0.72	1.14	1.64	2.10	0.43	0.92	0.93	1.56	7.30***	G > GA/I ($p=.05/.001$)
Evaluate	0.14	0.35	0.00	0.00	0.06	0.24	0.06	0.25	3.05	*NS*
Metacog Regulate	3.47	2.41	5.33	4.36	1.59	1.88	3.46	3.41	14.82***	G > GA > I ($p<.05$)
Emo/Mot Monitor	0.03	0.16	0.01	0.05	0.00	0.00	0.01	0.09	1.17	*NS*
Emo/Mot Control	0.03	0.12	0.05	0.24	0.28	0.63	0.12	0.41	4.76**	I > G/GA ($p<.05$)
Total Emo/Mot	0.07	0.19	0.06	0.24	0.28	0.63	0.14	0.41	3.75*	*NS*
Self Regulate	2.46	2.23	1.50	2.97	1.87	2.03	1.94	2.45	1.58	*NS*
Other Regulate	0.61	1.08	1.31	2.13	0.00	0.00	0.64	1.46	9.04***	G > I ($p<.001$)
Shared Regulate	0.60	1.10	2.79	4.37	0.00	0.00	1.13	2.85	12.76***	G > GA/I ($p<.001$)
Total Metacog	3.67	2.49	5.63	4.38	1.87	2.03	3.72	3.47	14.35***	G > GA > I ($p=.05$)

*$p < .05$; **$p < .01$; ***$p < .001$.

Typical examples of a child's attempts at regulation of another child included nonverbal monitoring efforts, in which a child checked or corrected the performance of another child through gesture and pointing, as well as the regulatory control of another child's behavior, where nonverbal actions were used to help or guide a peer through a task (e.g., pointing at a computer screen to indicate where another child should click the mouse, using a gesture to describe to a peer how one's hands should be held for catching a bean bag). Characteristic verbal behaviors seen in a child's attempts to regulate the cognition of others included monitoring behaviors evidenced in verbal instructions correcting another's performance (e.g., "No ... you can't go until the light is green!") as well as attempts to guide another child's actions in carrying out a task (e.g., "We're going to build a big house for Paws but you'll need a smaller house for Power Ranger, won't you?").

Nonverbal behaviors demonstrative of shared regulation during group observations were somewhat more subtle in their nature. Examples of behaviors in which regulation was a shared endeavor between two or more children were primarily made up of gestures related to the co-construction of the task, and included pointing to specific objects while discussing their use on task, drawing a peer's attention to an object that might be used to accomplish a mutually-agreed-upon goal (e.g., drawing peer's attention to a puzzle piece that child believes should be fitted next by waving it or pointing at a space while holding up a puzzle piece), and pointing to items on an interactive whiteboard in response to another child's request to show him which icon he should select next. Verbal behaviors indicative of shared regulation within group situations were evidenced in planning activities (e.g., in a role play situation, "I know… me and Harry could be the knights and you could be the peasant"), reflection activities (e.g., "We didn't need to use the sticky tape, we used the glue") and motivational monitoring ("Ours is going to be a lovely one!").

Interestingly, in the analysis at the level of 196 events, it appeared that adults working with children might stimulate them to deploy metacognitive knowledge more frequently. However, in the analysis of 60 events, no significant difference emerged between the three learning contexts ($p = .170$ NS). Intriguingly, in this analysis, children working individually showed significantly more evidence of emotional and motivational control than the children working in groups. This finding may well arise from the more frequent evidence of individual children resisting distraction or persisting on a task that was presenting difficulties. On the measure of total metacognitive behaviors (combining metacognitive knowledge, metacognitive regulation, and emotional and motivational regulation) the children working in groups without an adult once again showed significantly more evidence than those in supervised groups ($p < .05$), who in turn showed more evidence than the children working individually ($p < .05$).

Discussion

We have reported in this paper evidence supporting the view that children between 3 and 5 years of age are capable of a variety of metacognitive and self-regulatory behaviors, and that these are supported and facilitated particularly in peer-assisted learning contexts (i.e., when they are working in small groups without adult support or supervision. These contexts can involve either formally organized or informal peer-tutoring activities, as well as collaborative group work activities that might involve joint problem-solving, playing a game, re-enacting a story or other forms of imaginative play, or a range of other collaborative learning activities.

Methodologically, the present study clearly indicates the efficacy of observational studies of young children. One of the broader concerns of the present study, which will be the focus of a future paper, is to explore the possibility of identifying nonverbal as well as purely verbal indicators of metacognitive and self-regulatory processes in young children, both of which have been successfully identified and reliably coded within the present study. Much of the previous work, even with young children, has relied on traditional experimental and verbally based methodologies. The evidence of the present study would suggest that, largely as a consequence of the sensitivity of young children to context, previous research relying on young children's verbal performance in laboratory contexts has significantly underestimated the metacognitive and self-regulatory abilities of young children.

From a theoretical point of view, Vygotsky's contention that children's use of verbal tools to regulate the behavior of others is a significant factor or mechanism in their development of self-regulation seems clearly worthy of further investigation. To this we would also want to add "nonverbal" tools and gestures. Children working in groups without adults showed a significant increase in the kinds of "other" and "shared" regulation originally highlighted by Vauras et al. (2003). This is a significant theoretical advance that begins to help us to bring together the socio-cognitive Vygotskian perspective on self-regulation and development, and the more individualistic cognitive models arising from mostly American work related to adult metacognition and the tradition of John Flavell and Ann Brown. Certainly, the present study would encourage us to explore further the interplay between social contexts, particularly those affording opportunities for "other" and "shared" regulation, verbal and nonverbal modes of representation and communication, and children's metacognitive and self-regulatory development.

Within the educational sphere, given the now widely acknowledged significance of metacognitive and self-regulatory abilities for learning, there are clear implications of the present study, and other work in this area, for early education. There is currently international interest in fostering "independent learning" among young children, as attested by the current enthusiasm for such approaches as Reggio Emilia (Malaguzzi, 1993) and High Scope, (Schweinhart & Weikart, 1993) both of which emphasise children's autonomy and ownership of their learning, together with the value of making the processes of learning explicit to the child. We hope the present research will help to provide insights into the means by which these kinds of approaches provide significant benefits for young children's development as learners. The present data would certainly support the view that learning contexts that provoke and support metacognitive talk of various kinds would be likely to be highly beneficial. These contexts clearly need to include opportunities for young children (and probably students of all ages) to work and play in small groups without adult involvement.

We would not, however, wish this evidence to be taken to prove the limitations, in principle, of children working individually, or in groups with adult support. It may well be, to begin with, that when children are working in small groups they simply display evidence of metacognitive activity more explicitly; children working individually, or in a group with an adult may be enjoying rich metacognitive experiences, but entirely in their own internal mental world. We need to strive to develop methodologies that are increasingly sensitive to such internal mental processes (perhaps the methodologies of neuroscience, for example). We have also, as yet, not analyzed or discriminated between the practices of the adults when they were working with groups of children. It may well be that the overall pattern of results for "groups with an adult" is

hiding considerable individual variation (there are certainly some large standard deviations revealed in the analysis in Table 2), and that particular adults engaged in particular ways of working with groups of children on particular tasks provoked considerable metacognitive activity. This is clearly an area that could be explored fruitfully in further analyses. For now, however, what is established is that in the repertoire of learning contexts provided for young children in early educational settings, there is a strong case for the inclusion of opportunities for unsupervised collaborative group work, peer tutoring, and other forms of peer-assisted learning.

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Reśumé

Développement de la métacognition et de l'apprentissage autorégulé chez les jeunes enfants : le rôle de l'apprentissage coopératif assisté par des pairs

Les auteurs présentent les résultats d'une vaste étude de 2 ans qui porte sur le développement des capacités d'autorégulation et métacognitives chez de jeunes enfants (âgés de 3 à 5 ans) placés dans des contextes éducatifs écologiques au Royaume-Uni (*English Nursery and Reception classrooms*). Trois niveaux d'analyse ont été menés sur la base du codage des observations grâce à des catégories portant sur les comportements métacognitifs et les comportements d'autorégulation. Ces analyses permettent de soutenir que, de 3 à 5 ans, on obtient de nombreuses manifestations de comportements métacognitifs : ceux-ci sont plus fréquents pendant les activités d'apprentissage qui sont initiées par les enfants eux-mêmes, les engageant dans un travail à deux ou en petits groupes qui n'est pas supervisé par les adultes et qui exige que les enfants collaborent activement et communiquent verbalement (c'est-à-dire, des contextes d'apprentissage qui pourraient être caractérisés comme étant « assistés par un camarade »). Quand ils comparent ces données avec celles d'un travail individuel ou d'un travail en groupe réalisé avec l'aide d'un adulte, les auteurs notent que les enfants de cette classe d'âge qui travaillent en petits groupes sans supervision de l'adulte ont montré plus d'autorégulation et de contrôle métacognitif. Quant aux enfants impliqués dans des groupes supervisés par l'adulte, ils ont aussi manifesté plus de régulation mutuelle et partagée. Les implications pour la recherche, la théorie et la pratique éducative sont discutées.

Resumen

Desarrollo de la Metacognición y el Aprendizaje Autorregulado en Niños Pequeños: el Rol del Aprendizaje Colaborativo y Asistido entre Iguales

Los autores presentan los hallazgos de un estudio longitudinal a lo largo de dos años que exploró el desarrollo de habilidades de autorregulación y metacognitivas en niños pequeños (3 a 5 años) en espacios naturales en el Reino Unido (Escuelas Infantiles Inglesas y clases de Recepción). Se llevaron a cabo tres niveles de análisis basados en la observación de categorías codificadas de comportamientos metacognitivos y autorregulados. Dichos análisis partieron de la base de que, en el rango de edad comprendido entre 3 y 5 años, había amplia evidencia de que los comportamientos metacognitivos ocurrían más frecuentemente durante las actividades de aprendizaje que eran iniciadas por los propios niños, implicados en el trabajo entre pares en pequeños grupos no supervisados por adultos, y que involucraban amplia colaboración y conversación (por ejemplo: contextos de aprendizaje que podrías ser caracterizados como aprendizaje asistido entre iguales).En comparación con el trabajo individual o en grupos con soporte de los adultos, los niños de ese rango de edad trabajando en grupos pequeños no supervisados mostraron más evidencia de monitorización cognitiva y control. En cambio, los niños que trabajaban en grupos supervisados mostraron más evidencia de regulación sobre los "otros" y "compartida". Igualmente, se discuten las implicaciones para la investigación, para la teoría y para la práctica educativa.

Zusammenfassung

Entwicklung von Metakognition und selbstgesteuertem Lernen bei jungen Kindern: die Rolle des kollaborativen Lernens im Kontext von Assistenz durch Peers

Die Autoren stellen Ergebnisse aus zwei großen Zwei-Jahres-Studien vor, in denen die Entwicklung selbstregulatorischer und metakognitiver Fähigkeiten bei jungen Kindern (3 bis 5 Jahre) in naturalistischen Erziehungskontexten im Vereinigten Königreich (englische Kindergarten und Aufnahmeklassen) untersucht wurden. Basierend auf Codierungen von Beobachtungsdaten in Kategorien metakognitiven und selbststeuernden Verhaltens wurden drei Ebenen der Analyse durchgeführt. Diese Analysen unterstützen die Auffassung, dass im Altersbereich von 3 bis 5 Jahren extensive Evidenz für metakognitives Verhalten besteht. Dies tritt am häufigsten bei selbstinitiierten Lernaktivitäten der Kinder auf, wenn diese paarweise oder in kleinen Gruppen zusammenarbeiten, nicht von Erwachsenen supervidiert werden und intensiv in Zusammenarbeit und Gespräche involviert sind (d.h. Lernkontexte, die als peer-assisted learning bezeichnet werden können). Bezogen auf Arbeitstätigkeit, die individuell oder in Gruppen mit Unterstützung durch Erwachsene geschieht, zeigten Kinder dieses Altersbereichs in nicht-supervidierten kleinen Gruppen mehr Evidenz für metakognitive Steuerung und Kontrolle. Bezogen auf Kinder in supervidierten Gruppen zeigten sie auch mehr Evidenz für "andere" und "geteilte" Steuerung. Die Implikationen für Forschung, Theorienbildung und schulische Praxis werden diskutiert.

Abstract Italiano

Sviluppo della metacognizione e dell'apprendimento autoregolato nei bambini: il ruolo dell' apprendimento collaborativo e Peer-Assisted

Gli autori presentano i risultati di un ampio studio durato due anni che ha esplorato lo sviluppo delle abilità metacognitive e di autoregolazione in bambini britannici (dai 3 ai 5 anni) inseriti in ambienti educativi reali (asili nido e prima classe di scuola d'infanzia). Sono stati condotti 3 livelli di analisi basati su griglie di osservazione di categorie di comportamenti metacognitivi e di autoregolazione. Queste analisi hanno confermato che, tra i 3 e i 5 anni, sono evidenti comportamenti metacognitivi che si manifestano più frequentemente durante le attività di apprendimento promosse dai bambini, e nei lavori in cui i bambini sono impegnati a coppie o in piccoli gruppi, non supervisionati da adulti, e che prevedono un'intensa collaborazione e discussione (per esempio situazioni che possono essere caratterizzate come apprendimento Peer-assisted). Relativamente al lavoro individuale o in gruppi con il supporto dell'adulto, i bambini in questa fascia di età coinvolti in piccoli gruppi senza la supervisione degli adulti dimostrano con più evidenza controllo e monitoraggio metacognitivo. Nei gruppi supervisionati i bambini hanno evidenziato maggiormente regolazione "altra" e "condivisa". Vengono discusse implicazioni per la ricerca, la teoria e la pratica educativa.

Appendix

C.Ind.Le Coding Scheme: Verbal and Nonverbal Indicators of Metacognition and Self-Regulation in 3- to 5-Year-Olds

<u>Metacognitive knowledge</u>

CATEGORY NAME	DESCRIPTION OF BEHAVIOR	EXAMPLES
Knowledge of persons A verbalization demonstrating the explicit expression of one's knowledge in relation to cognition or people as cognitive processors. It might include knowledge about cognition in relation to: - *Self*: Refers to own capabilities, strengths and weaknesses, or academic/ task preferences; comparative judgments about own abilities - *Others*: Refers to others' processes of thinking or feeling toward cognitive tasks - *Universals*: Refers to universals of people's cognition	▪ Refers to his/her own strengths or difficulties in learning and academic working skills ▪ Refers to others' strengths or difficulties in learning and academic working skills ▪ Talks about general ideas about learning	▪ *I can write my name* ▪ *I can count backwards* ▪ *I don't know how to sing the song*
Knowledge of tasks A verbalization demonstrating the explicit expression of one's own long-term memory knowledge in relation to elements of the task.	▪ Compares across tasks identifying similarities and differences ▪ Makes a judgment about the level of difficulty of cognitive tasks or rates the tasks on the basis of pre-established criteria or previous knowledge	▪ *They need to put their boots on. And when they put their boots on, they dig a hole*
Knowledge of strategies A verbalization demonstrating the explicit expression of one's own knowledge in relation to strategies used or performing a cognitive task, where a strategy is a cognitive or behavioral activity that is employed so as to enhance performance or achieve a goal.	▪ Defines, explains or teaches others how she/he has done or learned something ▪ Explains procedures involved in a particular task ▪ Evaluates the effectiveness of one or more strategies in relation to the context or the cognitive task.	▪ *We don't need to use the sticky tape, we can use the glue* ▪ *You have to point it up this end so that it is going to grow*

Metacognitive regulation

CATEGORY NAME	DESCRIPTION OF BEHAVIOR	EXAMPLES
Planning Any verbalization or behavior related to the selection of procedures necessary for performing the task, individually or with others	▪ Sets or clarifies task demands and expectations ▪ Sets goals and targets ▪ Allocates individual roles and negotiates responsibilities ▪ Decides on ways of proceeding with the task ▪ Seeks and collects necessary resources	▪ *I'm going to make a big circle* ▪ *I know… me and Harry could be the knights and you could be the peasant* ▪ Child compares two objects before deciding which to use on task
Monitoring Any verbalization or behavior related to the ongoing on-task assessment of the quality of task performance (of self or others) and the degree to which performance is progressing towards a desired goal	▪ Self- commentates ▪ Reviews progress on task (keeping track of procedures currently being undertaken and those that have been done so far) ▪ Rates effort on-task or rates actual performance ▪ Rates or makes comments on currently memory retrieval ▪ Checks behaviors or performance, including detection of errors ▪ Self-corrects ▪ Checks and/or corrects performance of peer	▪ *I think we've got one left* ▪ *This bit doesn't fit anywhere* ▪ *Hang on, we've got it a bit wrong here* ▪ Child stops mid-way through an action (placing puzzle piece), pauses and re-directs action to place it somewhere else
Control Any verbalization or behavior related to a change in the way a task had been conducted, as a result of cognitive monitoring	▪ Changes strategies as a result of previous monitoring ▪ Suggests and uses strategies in order to solve the task more effectively ▪ Applies a previously learnt strategy to a new situation ▪ Repeats a strategy in order to check the accuracy of the outcome ▪ Seeks help ▪ Uses nonverbal gesture as a strategy to support own cognitive activity ▪ Copies from or imitates a model ▪ Helps or guides another child using gesture	▪ *Let's have a practice* ▪ *Can you help me do it?* ▪ Child points to spots on a die as he counts ▪ Child looks at a physical model (example: word on whiteboard) repeatedly while completing a task ▪ Child points at computer screen or interactive whiteboard to indicate where another child should click the mouse
Evaluation Any verbalization (REFL-V)	▪ Reviews own learning or explains the task	▪ *He's done really well* ▪ *We learnt how to cut,*

or behavior (REFL-NV) related to reviewing task performance and evaluating the quality of performance.	▪ Evaluates the strategies used ▪ Rates the quality of performance ▪ Observes or comments on task progress ▪ Tests the outcome or effectiveness of a strategy in achieving a goal	*and how to stick things together* ▪ Child rotates scissors in hands while opening and closing them before initiating cutting activity

Emotional and motivational regulation

CATEGORY NAME	DESCRIPTION OF BEHAVIOR	EXAMPLES
Emotional/ motivational monitoring Any verbalization or behavior related to the assessment of the current emotional and motivational experiences regarding the task	The child: ▪ Express awareness of positive or negative emotional experience of a task ▪ Monitors own emotional reactions while being on a task	▪ That wasn't very nice ▪ It's a bit sad ▪ I don't want to be a peasant
Emotional/ motivational control Any verbalization or behavior related to the regulation of one's emotional and motivational experiences while on task	The child: ▪ Controls attention and resists distraction or returns to task after momentary distraction ▪ Self-encourages or encourages others ▪ Persists in the face of difficulty or remains in task without help	▪ Mine is going to be a lovely one ▪ Child looks towards activity of others in the classroom, then re-focuses on task at hand and resumes activity